The Potential Impact of Loss of Sea Ice on Alaska's Subarctic and Arctic Large Marine Ecosystems

NOAA FISHERIES

Presented By

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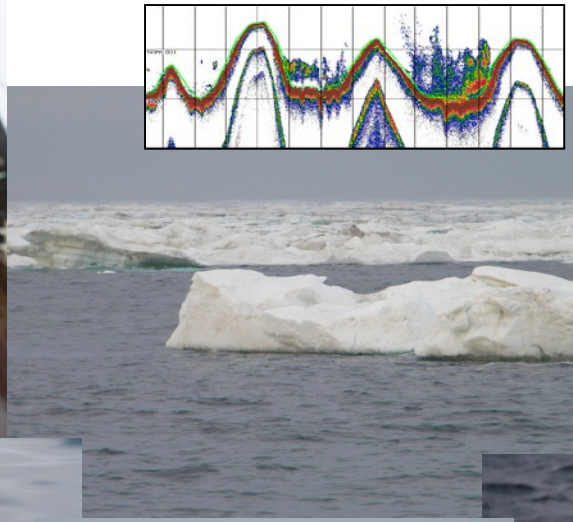
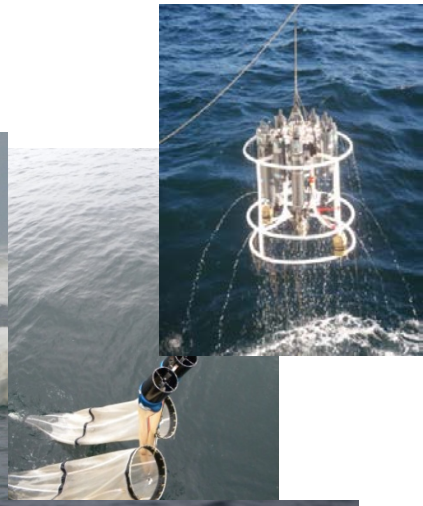
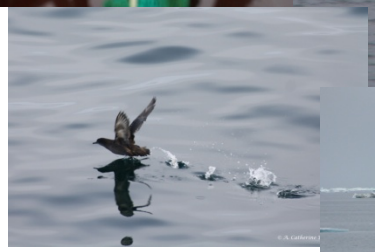
Alaska Fisheries Science Center

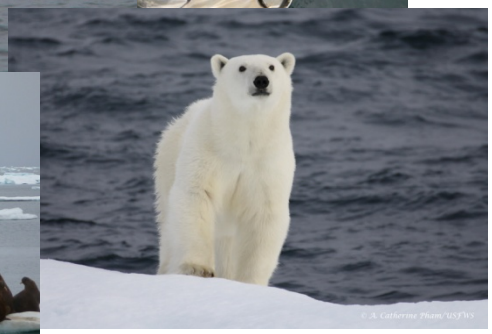
Auke Bay Laboratories

Juneau, Alaska





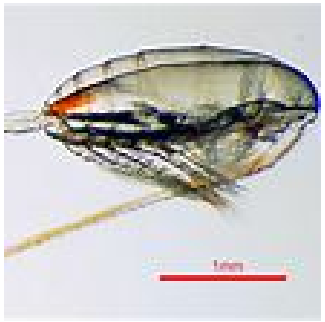




Sea Ice Impacts **FAT** (LIPID) Available to Fish

Fish Food!

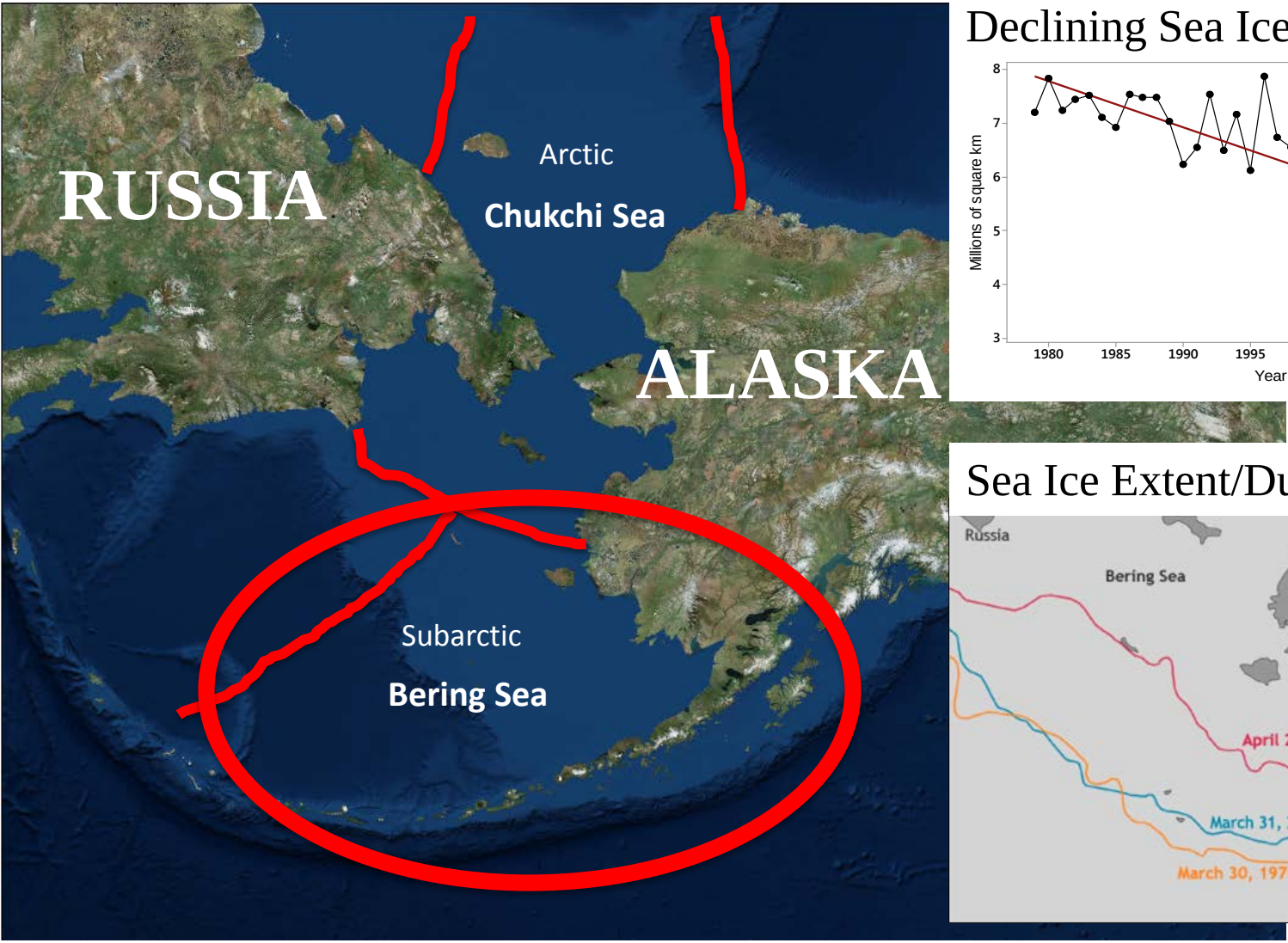
Large
Zooplankton



Omega 3 benefit to Humans

- Ease Depression
- Lower Cholesterol
- Eliminate Joint Pain
- Promotes Weight Loss
- Reduced Risk of Heart Disease

Sea Ice In Arctic and Subarctic Ecosystems

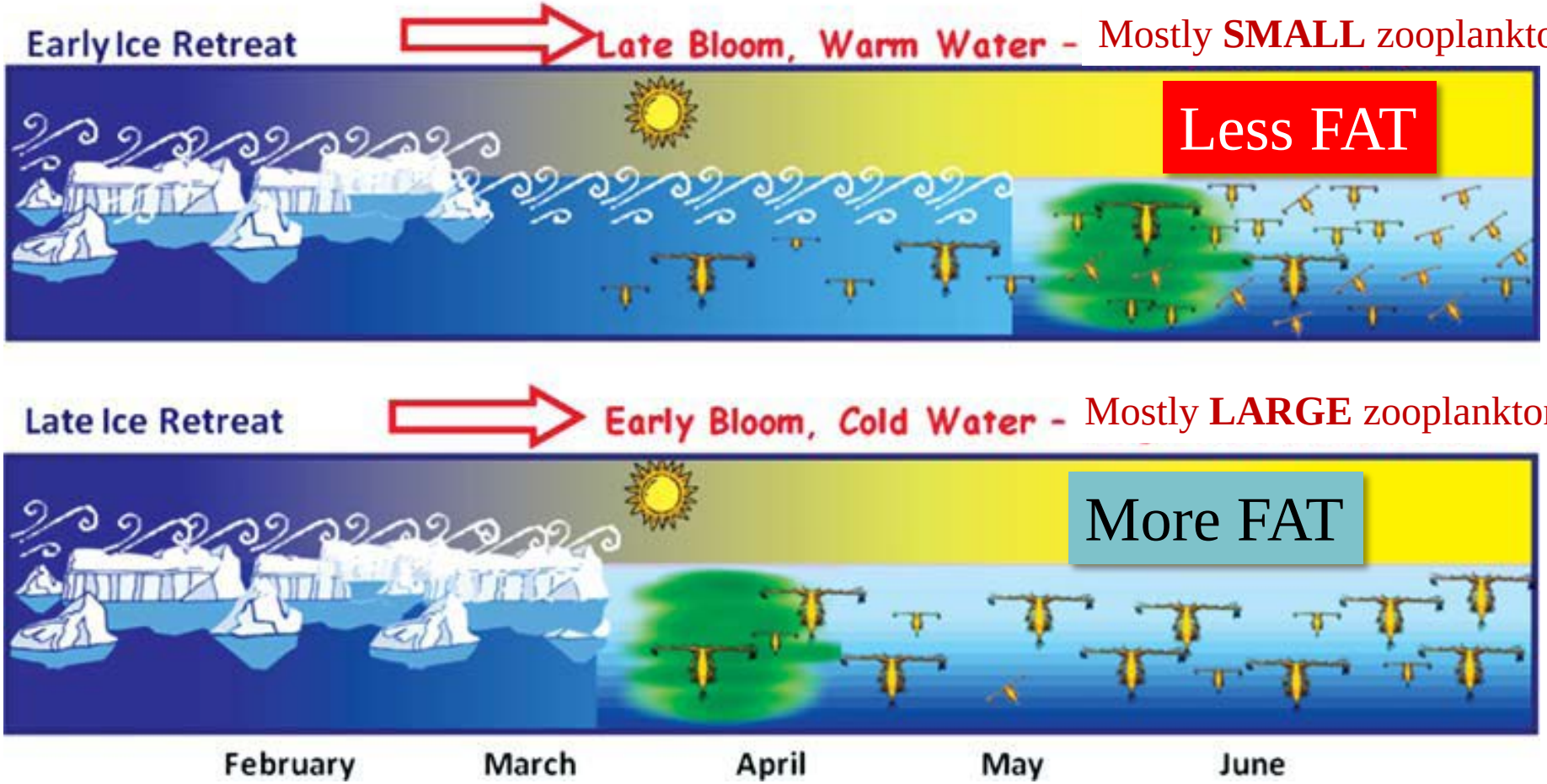


Declining Sea Ice Extent (Sept)

Sea Ice Extent/Duration (Spring)

Adapted from Large Marine Ecosystems of the Arctic area, Revision of the Arctic LME map, Protection of the Arctic Marine Environment, Arctic Council, May 15, 2013.

Time of Sea ice Retreat and Zooplankton (Fish Food) **Fat** Content

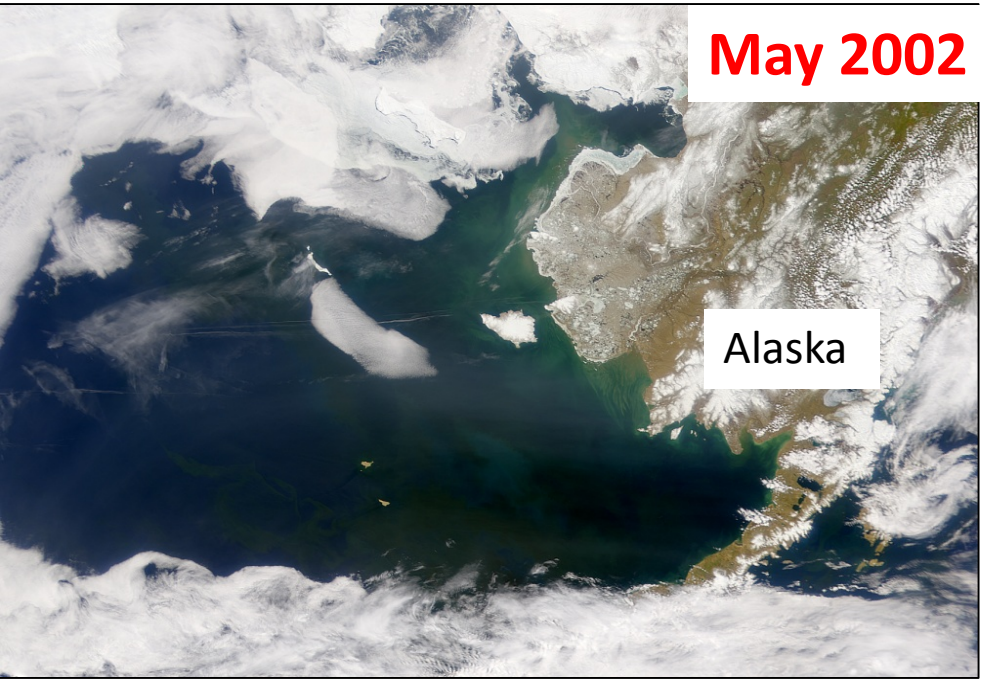


Hunt, G. L, K.O. Coyle, L.B. Eisner, E.V. Farley, R.A. Heintz, F. Mueter, J.M. Napp, J.E. Overland, P.H. Ressler, S. Salo, and P.J. Stabeno. 2011. Climate impacts on eastern Bering Sea foodwebs: a synthesis of new data and an assessment of the Oscillating Control Hypothesis.

Example: Spring Ice Extent

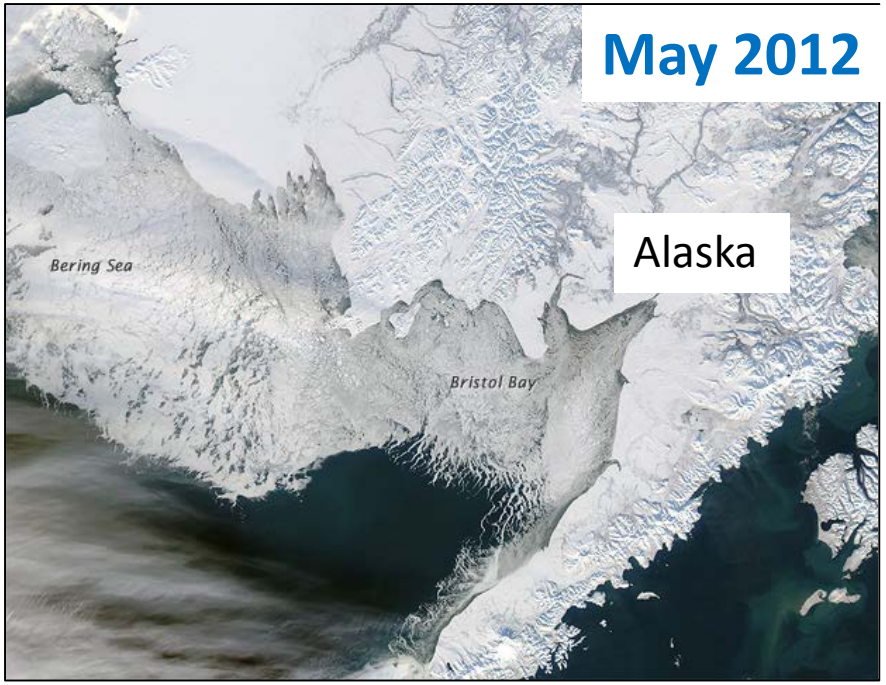
Early Ice Retreat

2002 to 2005

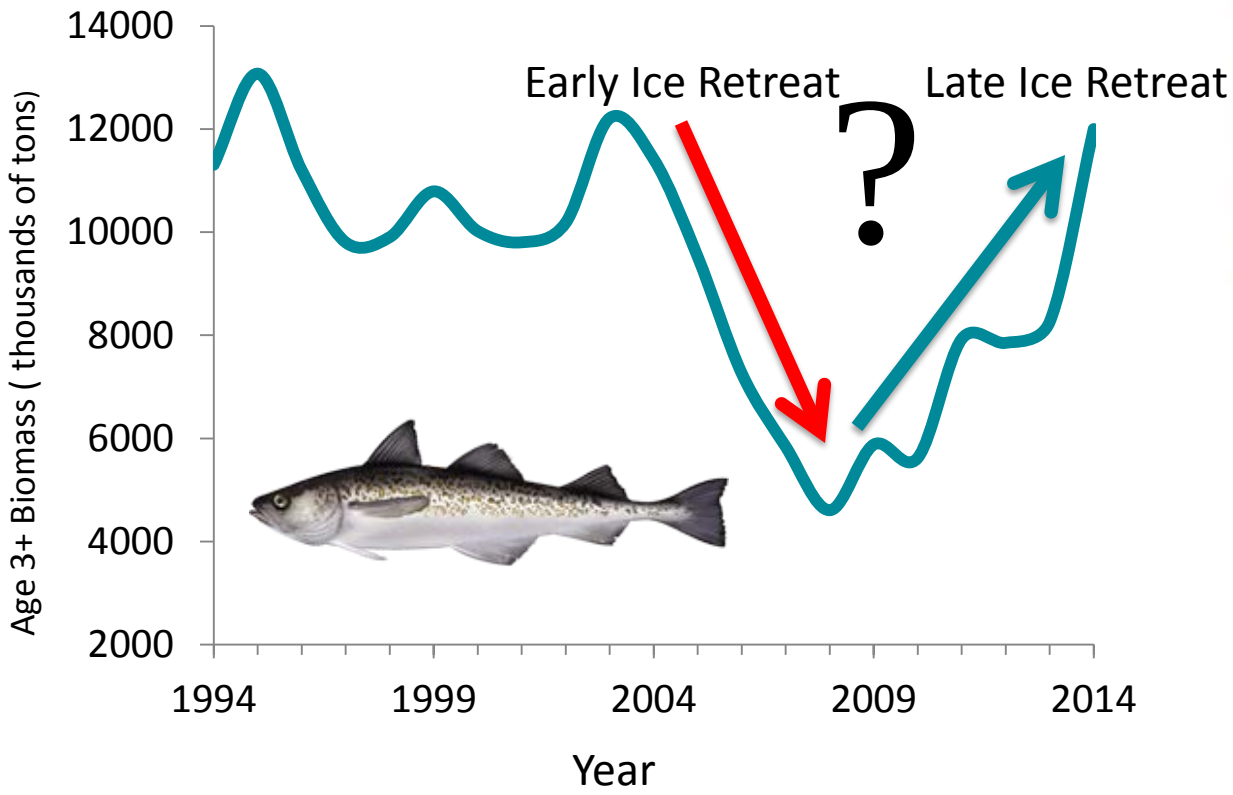


Late Ice Retreat

2007 to 2012



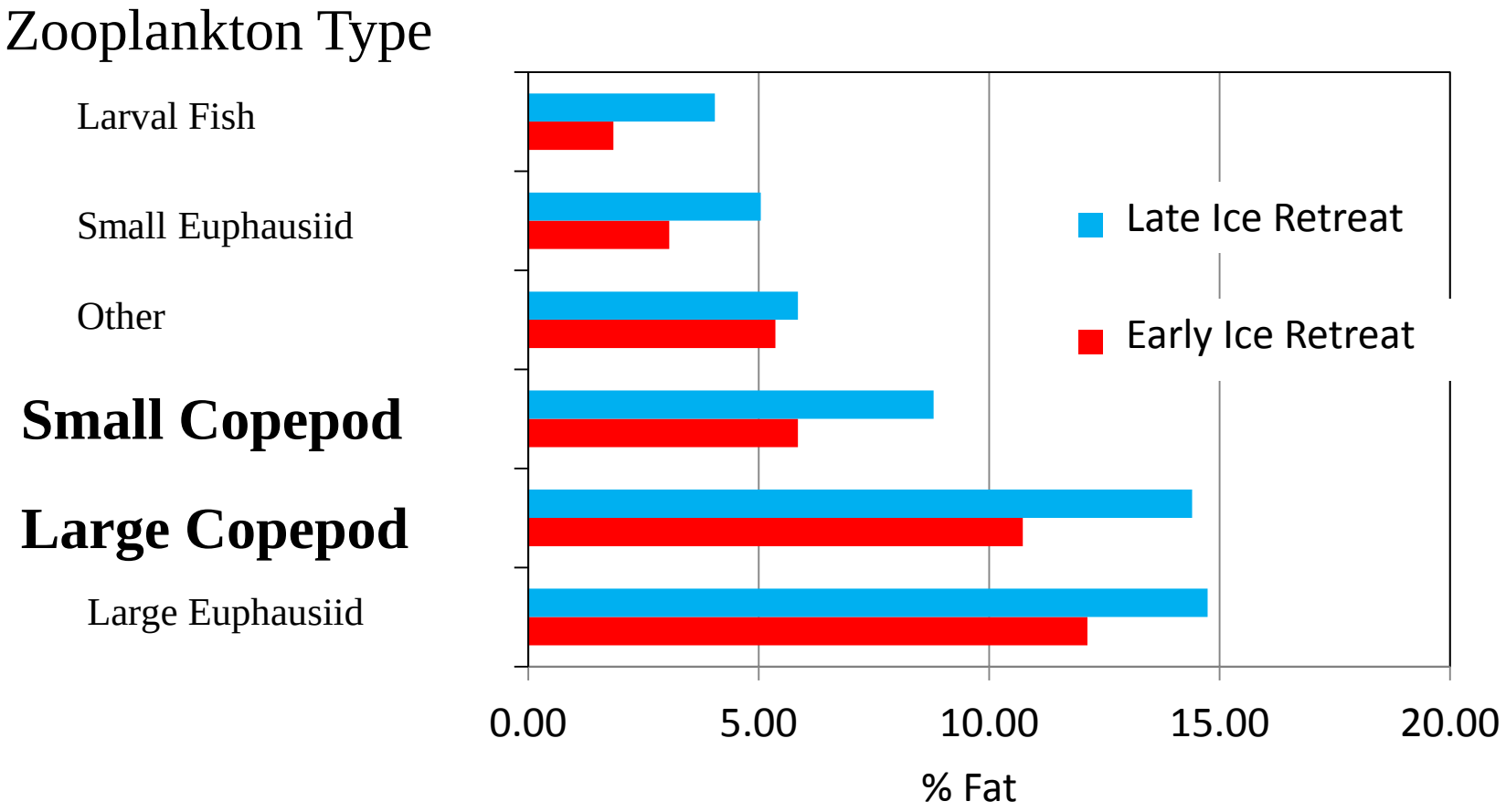
Sea Ice Extent and Walleye Pollock Fishery



The chartered fishing vessel *Vesteraalen*. (Photo by Jay Orr)

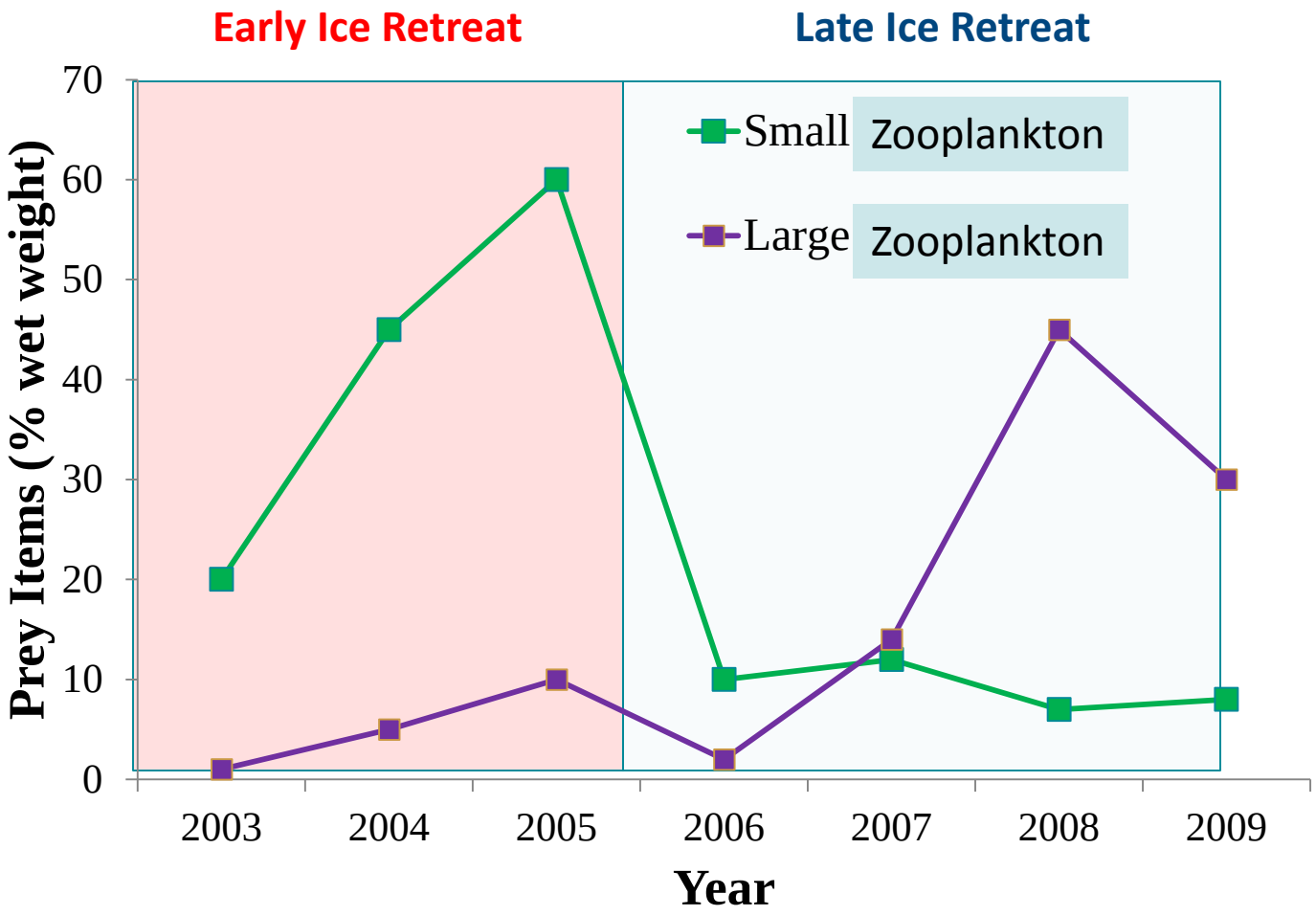
- Commercial value = $497.0 million (2012 McDowell Group)
- 40% drop in available pollock catch from 2004 to 2008

Late Ice Retreat = Higher **FAT** Content in Zooplankton



Heintz, R.A., E.C. Siddon, E.V. Farley, Jr., and J.M. Napp. 2013. Correlation between recruitment and fall condition of age-0 pollock from the eastern Bering Sea under varying climate conditions. Deep Sea Res. II 94:150-156.

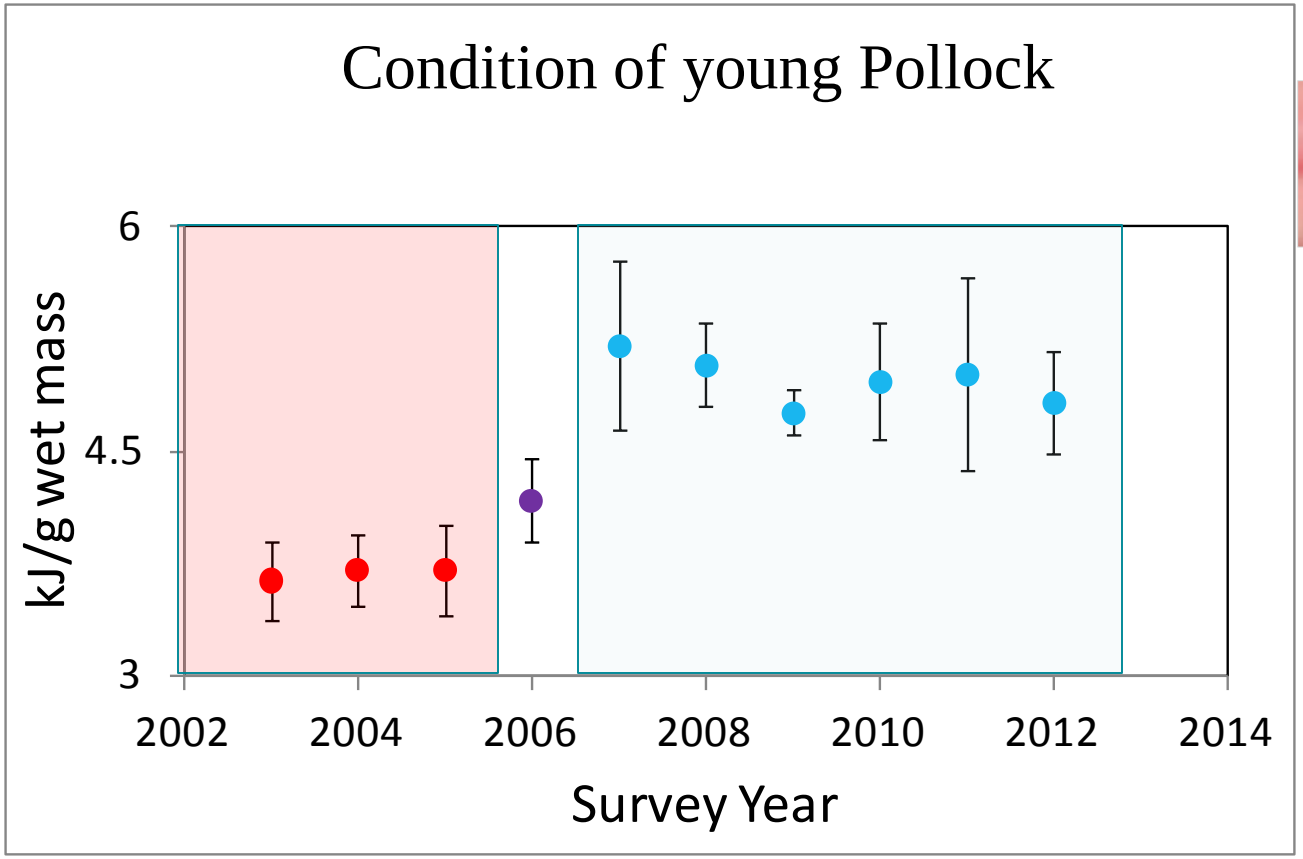
Shifts in Walleye Pollock Diet



Coyle, K.O., L.B. Eisner, F.J. Mueter, A.I. Pinchuk, M.A. Janout, K.D. Cieciel, E.V. Farley, and A.G. Andrews. 2011. Climate change in the southeastern Bering Sea: impacts on pollock stocks and implications for the oscillating control hypothesis. Fish. Oceanogr. 20:139-156.

You are what you eat!

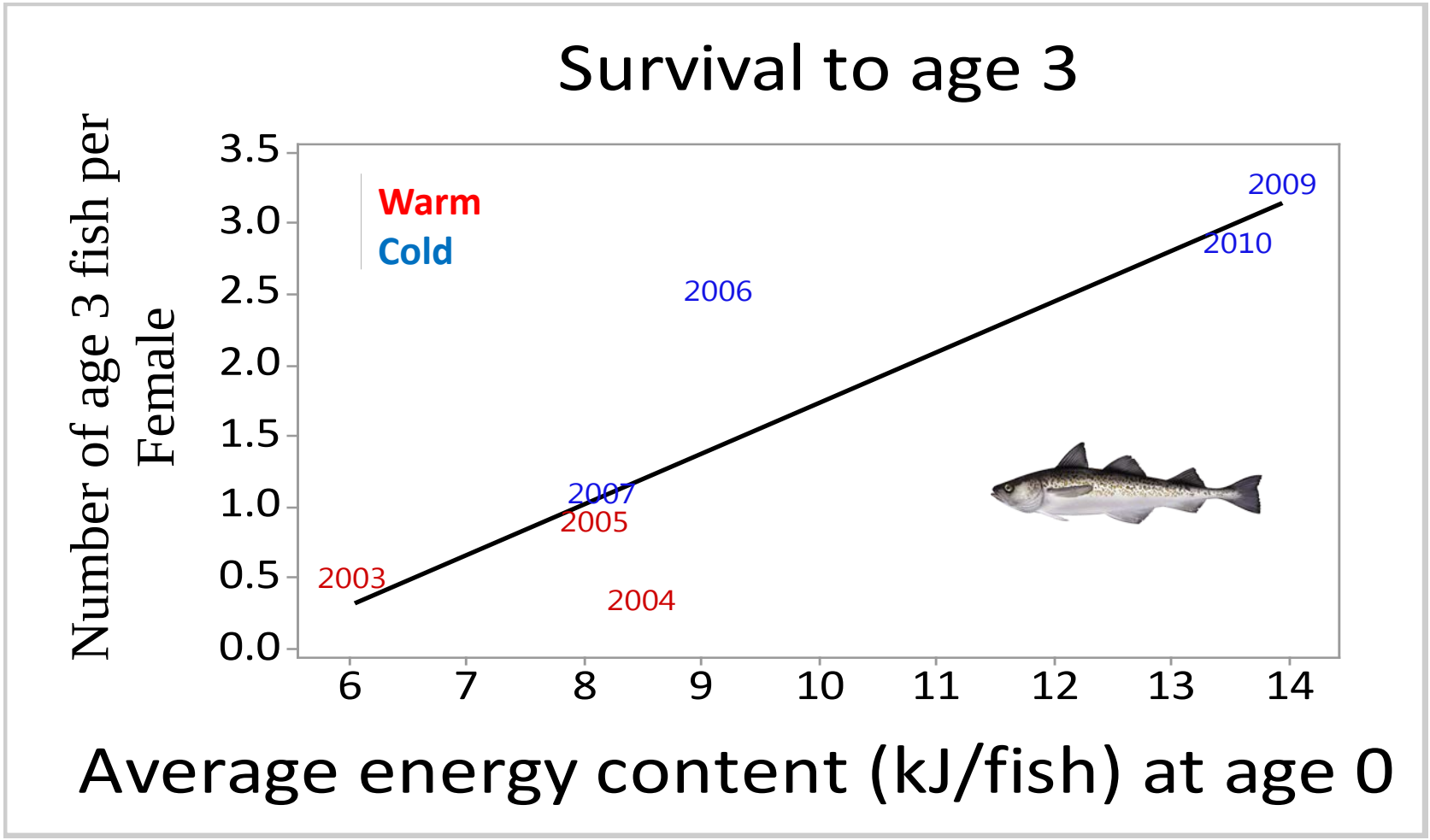
Early Ice Retreat **Late Ice Retreat**



Fish store more FAT during years with Late Ice Retreat

Heintz, R.A., E.C. Siddon, E.V. Farley, Jr., and J.M. Napp. 2013. Correlation between recruitment and fall condition of age-0 pollock from the eastern Bering Sea under varying climate conditions. Deep Sea Res. II 94:150-156.

Amount of **FAT** stored before winter = Higher Survival



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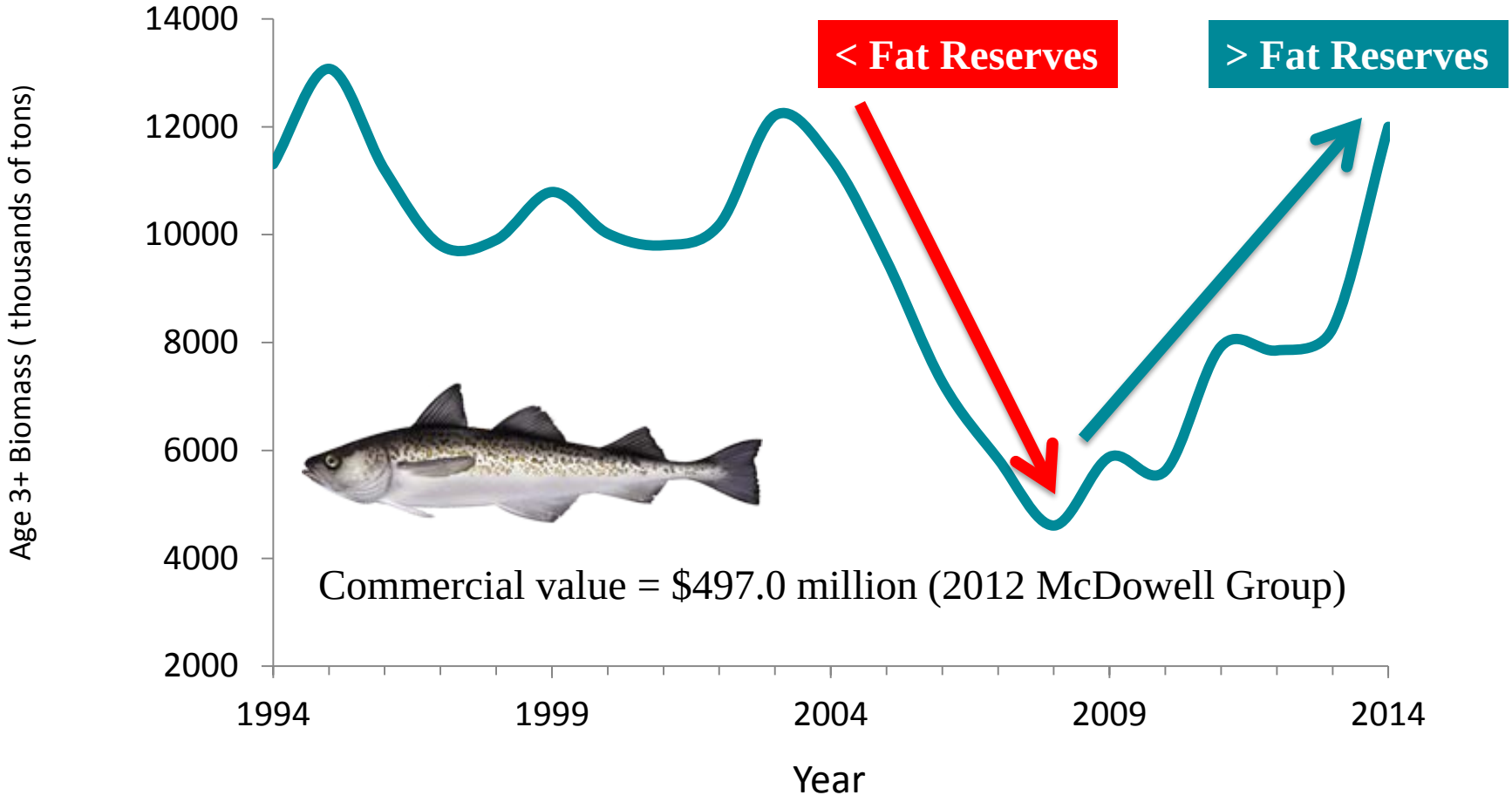
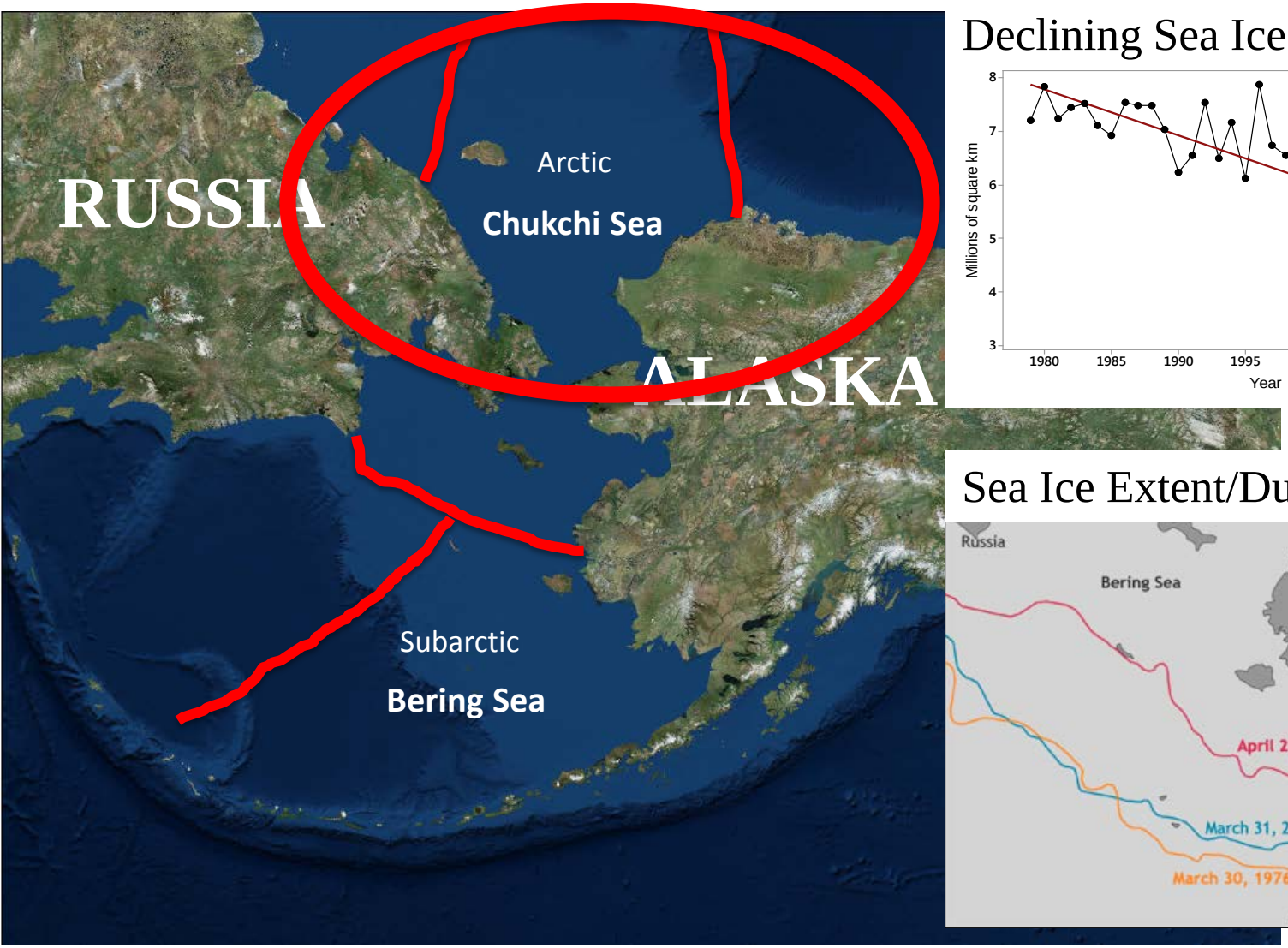
Timing of **Sea Ice Retreat** = Fish **Food Quality** = Walleye pollock **survival**



Ianelli, J.N., T. Honkaleto, S. Barbeaux, S. Kotwicki, K. Aydin, and N. Williamson. 2013. Assessment of the walleye pollock stock in the eastern Bering Sea. NPFMC Bering Sea and Aleutian Islands, Stock Assessment and Fishery Evaluation report.

Sea Ice In Arctic and Subarctic Ecosystems



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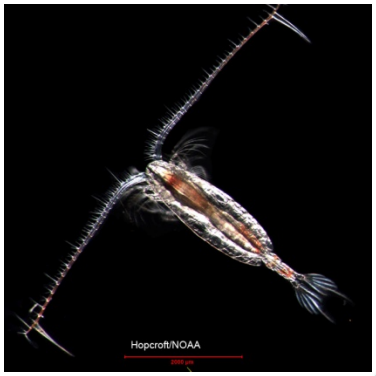
In the Arctic, It's Survival of the **Fattest**

Polar Bear

Ice seals

Food Web



Zooplankton

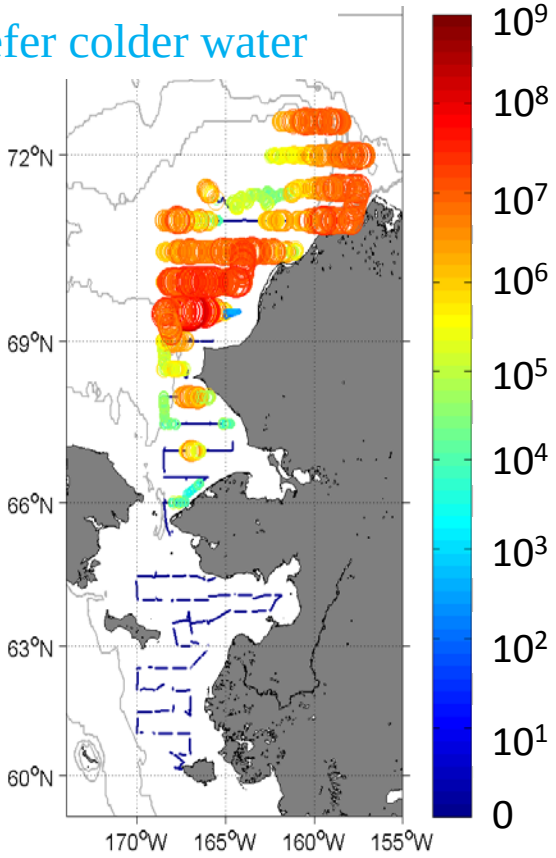
Arctic cod

Summer Distribution and Abundance of Young Arctic and Saffron Cod

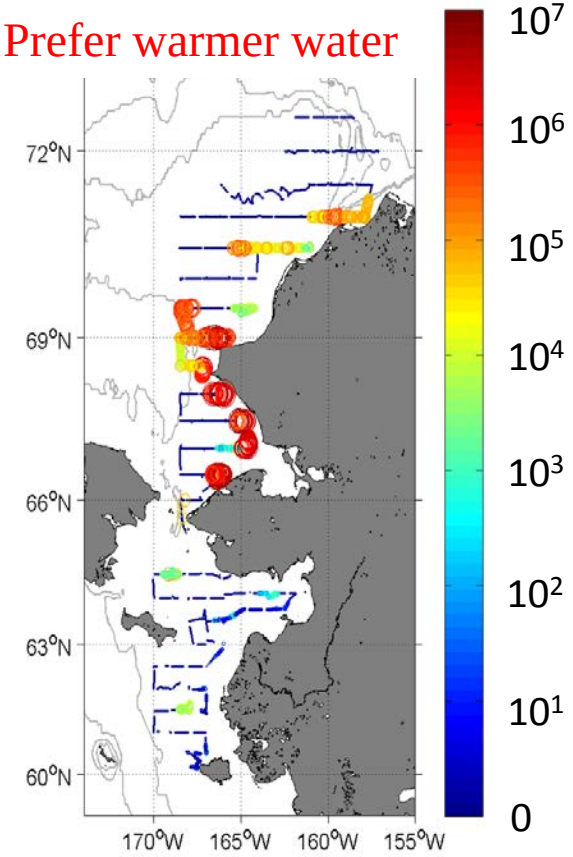
Arctic cod
($2.6 \cdot 10^{11}$ fish)

Saffron cod
($6.5 \cdot 10^{9}$ fish)

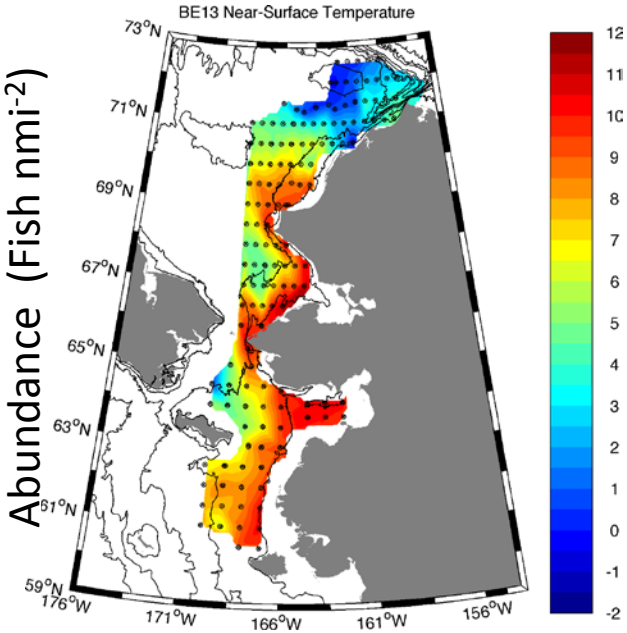
Prefer colder water



Prefer warmer water

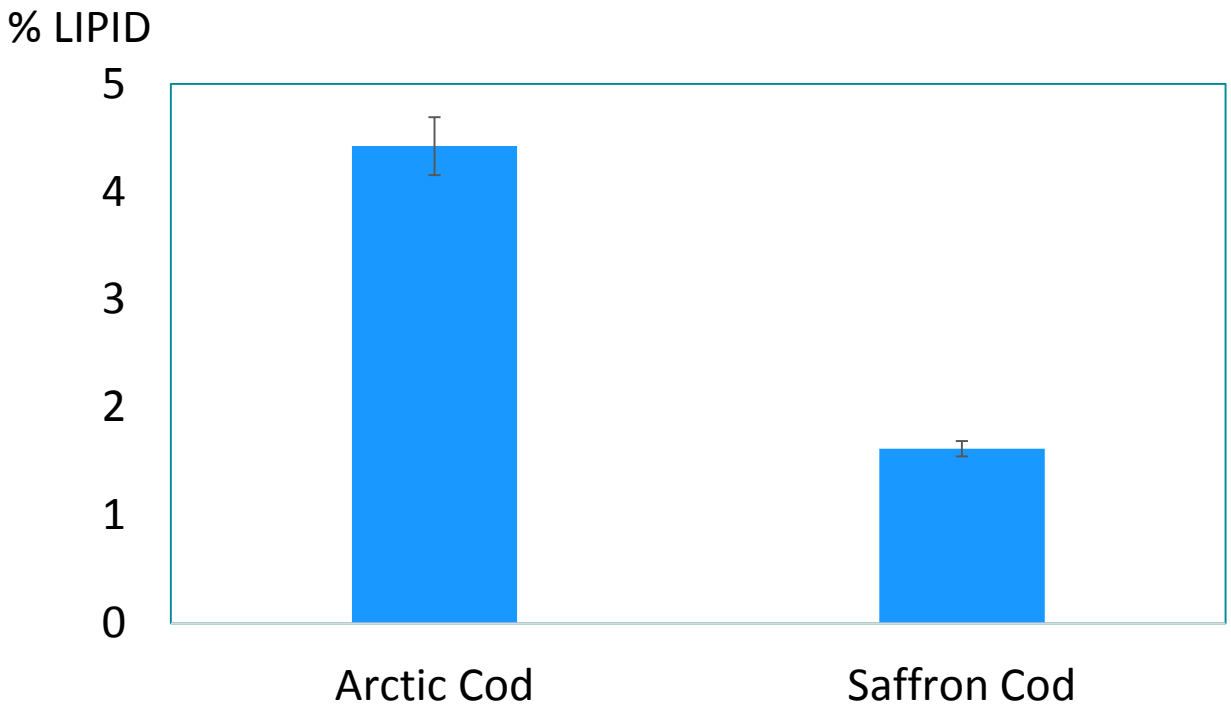


Sea Surface Temperatures

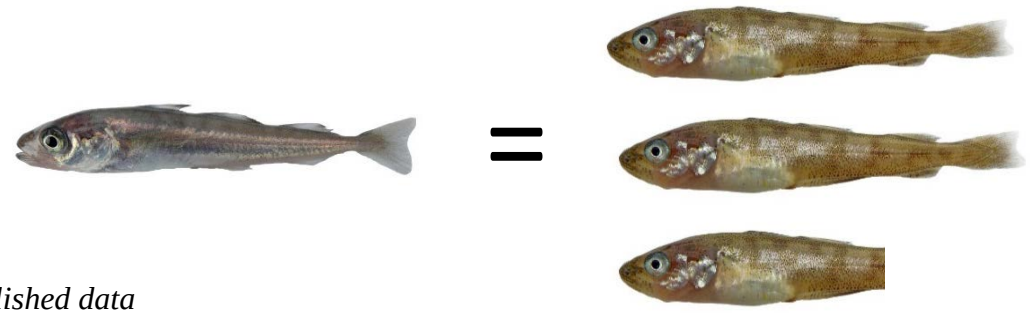


Data are from the Arctic Ecosystem Integrated Survey - see https://web.sfos.uaf.edu/wordpress/arcticeis/ for more information

Fat Content of Cods

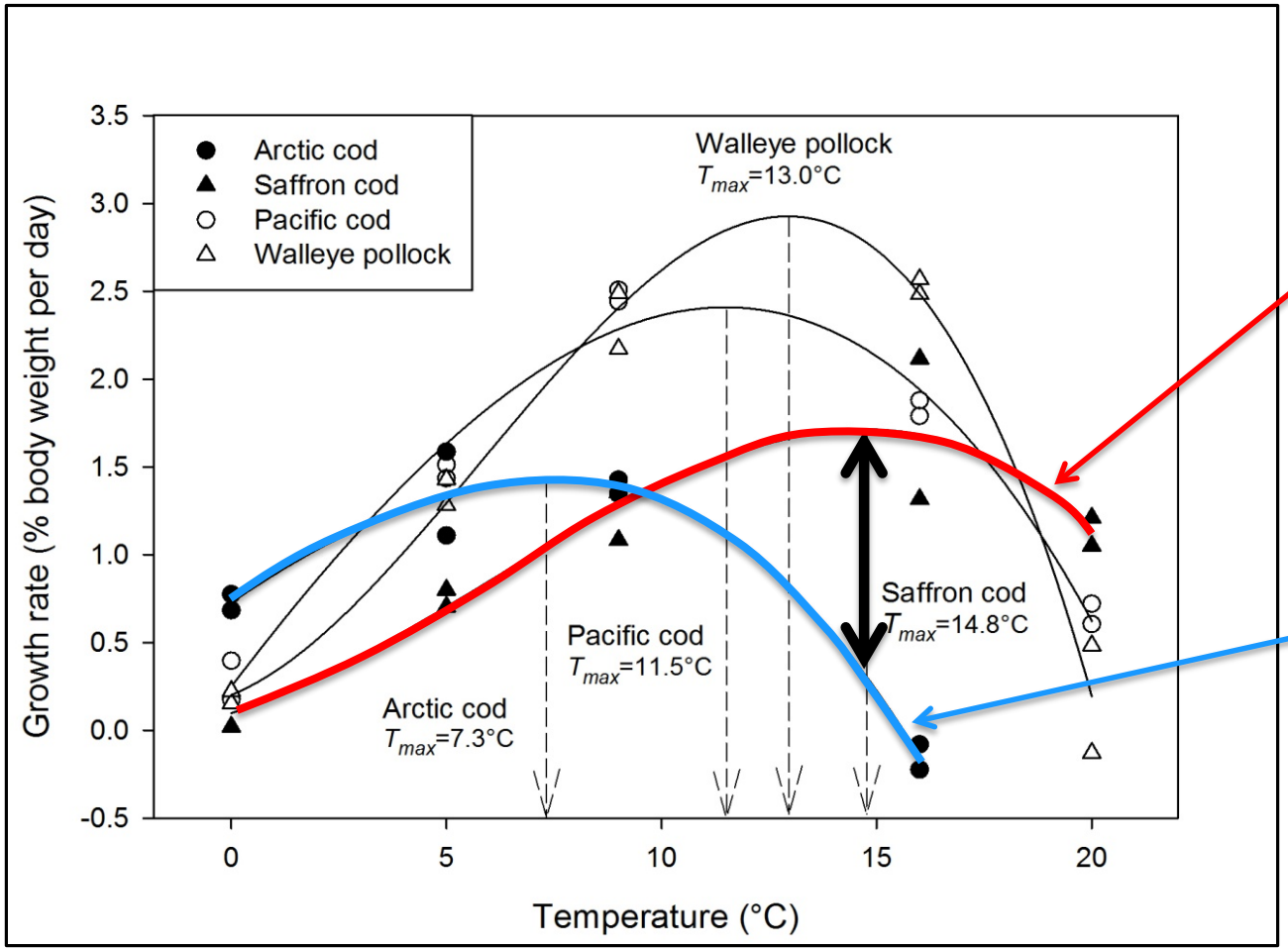


Predators must consume 2.7x the Saffron Cod to get the same lipid as 1 Arctic Cod



Heintz & Vollenweider Unpublished data

Growth Response in Relation to Temperature

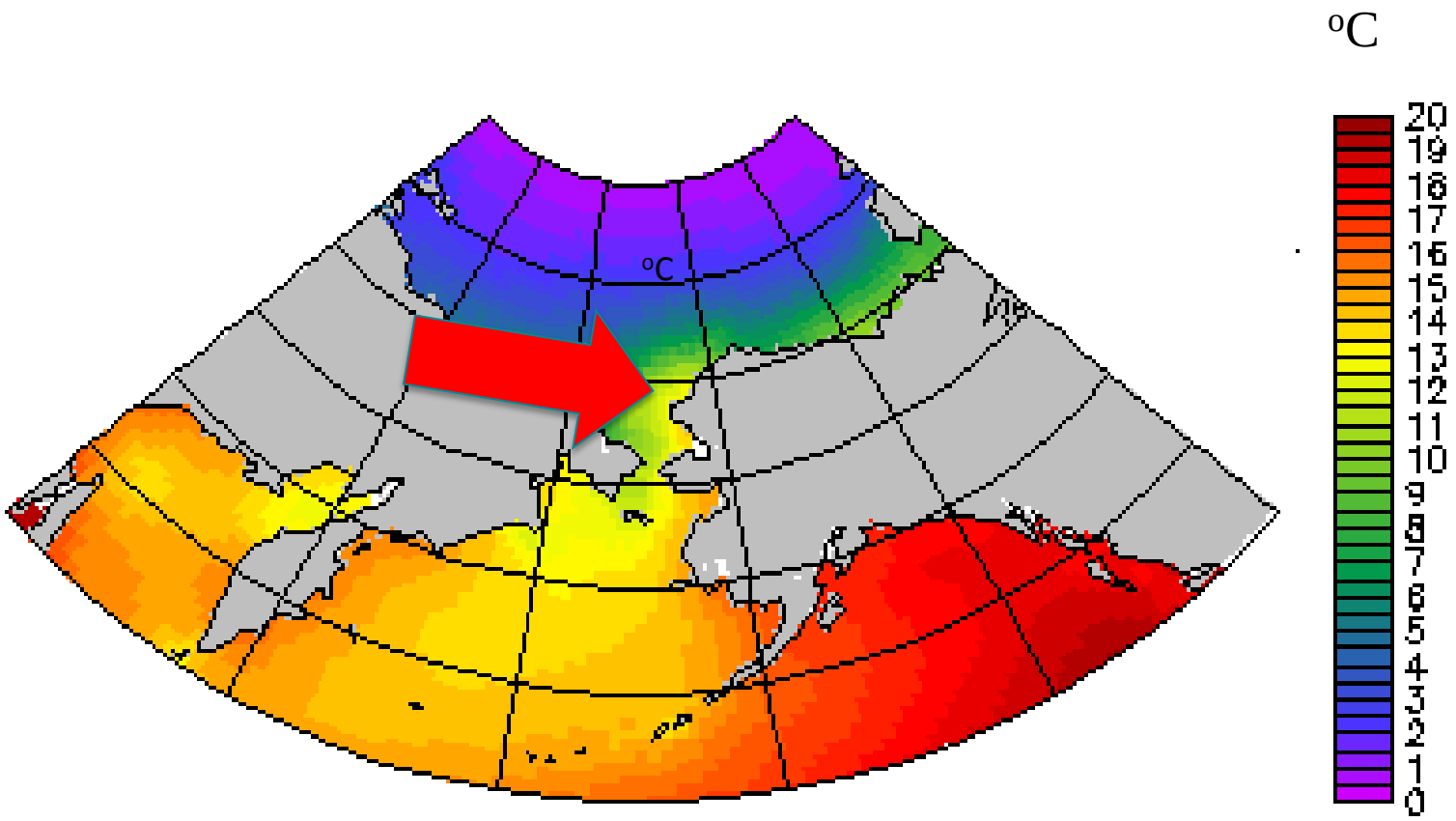


Saffron cod

Arctic cod

Ben Laurel, In Review

Summer Sea Surface Temperature Model Projections 2081 to 2100



Water will be too warm for Arctic Cod?

Courtesy of Muyin Wang, Pacific Marine Environmental Laboratory, Seattle, WA

Conclusion

Reduced sea ice extent and duration in Alaska's Arctic and Subarctic ecosystems will limit the available **HIGH FAT** prey that Fish and Mammals require for good health and survival.

This has the potential of affecting some of the most important commercial fisheries in Alaska and could impact marine mammal populations in the Arctic that Alaskan's depend on for food.